

AMENDMENTS TO THE CLAIMS

Please cancel Claims 46 through 48, 85 through 97, 104 through 107, 112, 117 through 120, 125, 130 through 133 and 138 without prejudice to or disclaimer of the subject matter recited therein. Please amend Claims 13, 23, 24, 38, 83, 139, 156, and 172 to read as follows:

1-12. (Canceled)

13. (Currently Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a predetermined wavelength under a first mask-illumination condition, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask with light of the predetermined wavelength under a second mask-illumination condition, different from the first mask-illumination condition, to superposedly print a second pattern on the predetermined exposure region where the first pattern has been printed,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process, and

wherein an exposure amount applied by said first exposure means to the predetermined exposure region is less than a permissible exposure amount.

14. (Previously Presented) An exposure apparatus according to Claim 13, wherein, under the first mask-illumination condition, the predetermined mask is illuminated with a first sigma, and, under the second mask-illumination condition, the predetermined mask is illuminated with a second sigma, different from the first sigma.

15. (Previously Presented) An exposure apparatus according to Claim 13, wherein under the first mask-illumination condition, the predetermined mask is illuminated with a first numerical aperture, and, under the second mask-illumination condition, the predetermined mask is illuminated with a second numerical aperture, different from the first numerical aperture.

16. (Previously Presented) An exposure apparatus according to Claim 13, wherein, under the first mask-illumination condition, the predetermined mask is illuminated with light being obliquely incident thereon, and, under the second mask-illumination condition, the predetermined mask is illuminated with light being perpendicularly incident thereon.

17. (Previously Presented) An apparatus according to Claim 13, wherein the mask includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

18. (Original) An apparatus according to Claim 17, wherein there are plural opening patterns juxtaposed with each other.

19. (Previously Presented) An apparatus according to Claim 17, wherein the mask includes a phase shift pattern.

20. (Previously Presented) An apparatus according to Claim 17, wherein there is a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, disposed adjacent to the mask.

21. (Previously Presented) An apparatus according to Claim 13, wherein the mask is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

22. (Previously Presented) An apparatus according to Claim 13, wherein the mask is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

23. (Currently Amended) An apparatus according to ~~any one of Claims~~ Claim 13, ~~+16~~, wherein the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

24. (Currently Amended) An apparatus according to ~~any one of Claims~~
Claim 13, -16, wherein exposures of the exposure region under different illumination conditions
are performed simultaneously without interference of lights in the different illumination
conditions.

25. (Previously Presented) A device manufacturing method, comprising
the steps of:
exposing a wafer to a pattern on a mask by use of an exposure apparatus as recited
Claim 13; and
developing the exposed wafer.

26-37. (Canceled)

38. (Currently Amended) An exposure apparatus comprising:
an illumination optical system for illuminating a predetermined mask;
a projection optical system for projecting light from the mask to a predetermined
exposure region;
first exposure means for illuminating the mask under a first illumination condition
and for projecting light from the mask to the exposure region at a first spatial frequency passage
spectrum of the projection system, so that the exposure region is exposed with a ~~second~~ first
pattern; and

second exposure means for illuminating the mask under a second illumination condition, different from the first illumination condition, and for projecting light from the mask to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with a second pattern,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process, and

wherein an exposure amount applied by said first exposure means to the predetermined exposure region is less than a permissible exposure amount.

39. (Previously Presented) An exposure apparatus comprising:

an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for illuminating the mask with a first sigma and for projecting light from the mask to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with a first pattern; and

second exposure means for illuminating the mask with a second sigma, different from the first sigma, and for projecting light from the mask to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with a second pattern,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

40. (Previously Presented) An exposure apparatus comprising:
an illumination optical system for illuminating a predetermined mask;
a projection optical system for projecting light from the mask to a
predetermined exposure region;

first exposure means for illuminating the mask with a first numerical aperture and for projecting light from the mask to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with a first pattern; and

second exposure means for illuminating the mask with a second numerical aperture, different from the first numerical aperture, and for projecting light from the mask to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with a second pattern,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

41. (Previously Presented) An exposure apparatus comprising:
an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for obliquely illuminating the mask and for projecting light from the mask to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with a first pattern; and

second exposure means for perpendicularly illuminating the mask and for projecting light from the mask to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with a second pattern,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

42. (Previously Presented) An apparatus according to any one of Claims 38 - 41, wherein the mask includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

43. (Original) An apparatus according to Claim 42, wherein there are plural opening patterns juxtaposed with each other.

44. (Previously Presented) An apparatus according to Claim 42, wherein the mask includes a phase shift pattern.

45. (Previously Presented) An apparatus according to any one of Claims 38 - 41, wherein one of a shape of an aperture opening of the projection optical system and a transmission factor distribution is changed to change the spatial frequency passage spectrum of the projection optical system.

46-48. (Cancelled)

49. (Previously Presented) An apparatus according to any one of Claims 38 - 41, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without interference of lights in the different illumination conditions.

50. (Previously Presented) A device manufacturing method, comprising the steps of:

exposing a wafer to a pattern on a mask by use of an exposure apparatus as recited in any one of Claims 38 - 41; and

developing the exposed wafer.

51-62. (Canceled)

63. (Previously Presented) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a predetermined wavelength under a first illumination condition, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the mask with light of the predetermined wavelength under a second illumination condition, different from the first illumination condition, to print a second pattern on the predetermined exposure region,

wherein the mask has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

64. (Previously Presented) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a first sigma, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the mask with light of a second sigma, different from the first sigma, to print a second pattern on the predetermined exposure region,

wherein the mask has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

65. (Previously Presented) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a first numerical aperture, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the mask with light of a second numerical aperture, different from the first numerical aperture, to print a second pattern on the predetermined exposure region,

wherein the mask has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

66. (Previously Presented) An exposure apparatus, comprising:

first exposure means for obliquely illuminating a predetermined mask, to print a first pattern on a predetermined exposure region; and

second exposure means for perpendicularly illuminating the mask to print a second pattern on the predetermined exposure region,

wherein the mask has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

67. (Previously Presented) An apparatus according to any one of Claims 63 - 66, wherein the mask includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

68. (Original) An apparatus according to Claim 67, wherein there are plural opening patterns juxtaposed with each other.

69. (Previously Presented) An apparatus according to Claim 67, wherein the mask includes a phase shift pattern.

70. (Original) An apparatus according to Claim 67, wherein there is an auxiliary pattern disposed adjacent to the opening pattern.

71. (Previously Presented) An apparatus according to any one of Claims 63 - 66, wherein the mask is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

72. (Previously Presented) An apparatus according to any one of Claims 63 - 66, wherein the mask is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

73. (Previously Presented) An apparatus according to any one of Claims 63 - 66, wherein the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

74. (Previously Presented) An apparatus according to any one of Claims 63 - 66, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without mutual interference of lights in the different illumination conditions.

75. (Previously Presented) A device manufacturing method, comprising the steps of:

exposing a wafer to a pattern on a mask by use of an exposure apparatus as recited in any one of Claims 63 - 66; and

developing the exposed wafer.

76-82. (Canceled)

83. (Currently Amended) An exposure apparatus comprising:
an illumination optical system for illuminating a predetermined mask;
a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for illuminating the mask under a first illumination condition and for projecting light from the mask to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with a first pattern; and

second exposure means for illuminating the mask under a second illumination condition, different from the first illumination condition, and for projecting light from the mask to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with a second pattern,

wherein the mask has a repetition pattern comprising repeatedly disposed basic patterns, being defined by light transmissive portions,

wherein light passed through adjacent basic patterns of the repetition pattern have a mutual optical phase difference of about 180 deg., and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process, and

wherein an exposure amount applied by said first exposure means to the predetermined exposure region is less than a permissible exposure amount.

84-97. (Canceled)

98. (Previously Presented) An apparatus according to Claim 83, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without interference of lights in the different illumination conditions.

99. (Previously Presented) A device manufacturing method, comprising the steps of:

exposing a wafer to a pattern on a mask by use of an exposure apparatus as recited in Claim 83; and

developing the exposed wafer.

100. (Previously Presented) An apparatus according to Claim 13, wherein the illumination of the mask is performed with bright field illumination.

101. (Previously Presented) An apparatus according to Claim 14, wherein the illumination of the mask is performed with bright field illumination.

102. (Previously Presented) An apparatus according to Claim 15, wherein the illumination of the mask is performed with bright field illumination.

103. (Previously Presented) An apparatus according to Claim 16, wherein the illumination of the mask is performed with bright field illumination.

104-107. (Cancelled)

108. (Previously Presented) An apparatus according to Claim 63, wherein the illumination of the mask is performed with bright field illumination.

109. (Previously Presented) An apparatus according to Claim 64, wherein the illumination of the mask is performed with bright field illumination.

110. (Previously Presented) An apparatus according to Claim 65, wherein the illumination of the mask is performed with bright field illumination.

111. (Previously Presented) An apparatus according to Claim 66, wherein the illumination of the mask is performed with bright field illumination.

112. (Cancelled)

113. (Previously Presented) An apparatus according to Claim 13, wherein the exposure by said first exposure means produces a first region in which an

exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

114. (Previously Presented) An apparatus according to Claim 14, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

115. (Previously Presented) An apparatus according to Claim 15, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

116. (Previously Presented) An apparatus according to Claim 16, wherein the exposure by said first exposure means produces a first region in which an

exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

117-120. (Cancelled)

121. (Previously Presented) An apparatus according to Claim 63, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

122. (Previously Presented) An apparatus according to Claim 64, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

123. (Previously Presented) An apparatus according to Claim 65, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

124. (Previously Presented) An apparatus according to Claim 66, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

125. (Cancelled)

126. (Previously Presented) An apparatus according to Claim 13, wherein the first and second patterns have different shapes.

127. (Previously Presented) An apparatus according to Claim 14, wherein the first and second patterns have different shapes.

128. (Previously Presented) An apparatus according to Claim 15,
wherein the first and second patterns have different shapes.

129. (Previously Presented) An apparatus according to Claim 16,
wherein the first and second patterns have different shapes.

130-133. (Cancelled)

134. (Previously Presented) An apparatus according to Claim 63,
wherein the first and second patterns have different shapes.

135. (Previously Presented) An apparatus according to Claim 64,
wherein the first and second patterns have different shapes.

136. (Previously Presented) An apparatus according to Claim 65,
wherein the first and second patterns have different shapes.

137. (Previously Presented) An apparatus according to Claim 66,
wherein the first and second patterns have different shapes.

138. (Cancelled)

139. (Currently Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a predetermined wavelength under a first mask-illumination condition, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask with light of the predetermined wavelength under a second mask-illumination condition, to print a second pattern on the predetermined exposure region,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process, and

wherein exposures with said first and second exposure means are carried out simultaneously and so as to superposedly print the first pattern and the second pattern on the predetermined exposure region, and

wherein an exposure amount applied by said first exposure means to the predetermined exposure region is less than a permissible exposure amount.

140. (Previously Presented) An apparatus according to Claim 139,

wherein the light used by said first exposure means for illumination of the predetermined mask and the light used by said second exposure means for illumination of the predetermined mask have substantially mutually orthogonal polarization directions.

141. (Previously Presented) An exposure apparatus according to Claim 139, wherein, under the first mask-illumination condition, the predetermined mask is illuminated with a first sigma, and, under the second mask-illumination condition, the predetermined mask is illuminated with a second sigma, different from the first sigma.

142. (Previously Presented) An exposure apparatus according to Claim 139, wherein under the first mask-illumination condition, the predetermined mask is illuminated with a first numerical aperture, and, under the second mask-illumination condition, the predetermined mask is illuminated with a second numerical aperture, different from the first numerical aperture.

143. (Previously Presented) An exposure apparatus according to Claim 139, wherein, under the first mask-illumination condition, the predetermined mask is illuminated with light being obliquely incident thereon, and, under the second mask-illumination condition, the predetermined mask is illuminated with light being perpendicularly incident thereon.

144. (Previously Presented) An apparatus according to Claim 139, wherein the mask includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

145. (Previously Presented) An apparatus according to Claim 144, wherein there are plural opening patterns juxtaposed with each other.

146. (Previously Presented) An apparatus according to Claim 144, wherein the mask includes a phase shift pattern.

147. (Previously Presented) An apparatus according to Claim 144, wherein there is a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, disposed adjacent to the mask.

148. (Previously Presented) An apparatus according to Claim 139, wherein the mask is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

149. (Previously Presented) An apparatus according to Claim 139, wherein the mask is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

150. (Previously Presented) An apparatus according to Claim 139, wherein the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

151. (Previously Presented) An apparatus according to Claim 139, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without interference of lights in the different illumination conditions.

152. (Previously Presented) An apparatus according to Claim 139, wherein the illumination of the mask is performed with bright field illumination.

153. (Previously Presented) An apparatus according to Claim 139, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

154. (Previously Presented) An apparatus according to Claim 139, wherein the first and second patterns have different shapes.

155. (Previously Presented) A device manufacturing method, comprising the steps of:

exposing a wafer to a pattern on a mask by use of an exposure apparatus as recited in Claim 139; and

developing the exposed wafer.

156. (Currently Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a predetermined wavelength under a first mask-illumination condition, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask with light of the predetermined wavelength under a second mask-illumination condition, to print a second pattern on the predetermined exposure region,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process, and

wherein the state of polarization of the light used by said first exposure means for illumination of the predetermined mask is different from the state of polarization of and the light used by said second exposure means for illumination of the predetermined mask, ~~have substantially mutually orthogonal polarization directions~~ and

wherein an exposure amount applied by said first exposure means to the predetermined exposure region is less than a permissible exposure amount.

157. (Previously Presented) An exposure apparatus according to Claim 156, wherein, under the first mask-illumination condition, the predetermined mask is illuminated with a first sigma, and, under the second mask-illumination condition, the predetermined mask is illuminated with a second sigma, different from the first sigma.

158. (Previously Presented) An exposure apparatus according to Claim 156, wherein under the first mask-illumination condition, the predetermined mask is illuminated with a first numerical aperture, and, under the second mask-illumination condition, the predetermined mask is illuminated with a second numerical aperture, different from the first numerical aperture.

159. (Previously Presented) An exposure apparatus according to Claim 156, wherein, under the first mask-illumination condition, the predetermined mask is illuminated with light being obliquely incident thereon, and, under the second mask-illumination condition, the predetermined mask is illuminated with light being perpendicularly incident thereon.

160. (Previously Presented) An apparatus according to Claim 156, wherein the mask includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

161. (Previously Presented) An apparatus according to Claim 160, wherein there are plural opening patterns juxtaposed with each other.

162. (Previously Presented) An apparatus according to Claim 160, wherein the mask includes a phase shift pattern.

163. (Previously Presented) An apparatus according to Claim 160, wherein there is a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, disposed adjacent to the mask.

164. (Previously Presented) An apparatus according to Claim 156, wherein the mask is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

165. (Previously Presented) An apparatus according to Claim 156, wherein the mask is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

166. (Previously Presented) An apparatus according to Claim 156, wherein the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

167. (Previously Presented) An apparatus according to Claim 156, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without interference of lights in the different illumination conditions.

168. (Previously Presented) An apparatus according to Claim 156, wherein the illumination of the mask is performed with bright field illumination.

169. (Previously Presented) An apparatus according to Claim 156, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

170. (Previously Presented) An apparatus according to Claim 156, wherein the first and second patterns have different shapes.

171. (Previously Presented) A device manufacturing method, comprising the steps of:

exposing a wafer to a pattern on a mask by use of an exposure apparatus as recited in Claim 156; and

developing the exposed wafer.

172. (Currently Amended) An exposure apparatus, comprising:
first exposure means for illuminating a predetermined mask with first light having a first polarization ~~direction~~ state, under a first mask-illumination condition; and
second exposure means for illuminating the predetermined mask with second light having a second polarization ~~direction being substantially orthogonal~~ state different from to the first polarization ~~direction~~ state, under a second mask-illumination condition,
wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out substantially simultaneously, prior to a development process, and
wherein an exposure amount applied by said first exposure means to the predetermined exposure region is less than a permissible exposure amount.

173. (Previously Presented) An apparatus according to Claim 172, wherein said first exposure means is effective to print a first pattern on a predetermined exposure region, and said second exposure means is effective to print a second pattern on the predetermined exposure region.

174. (Previously Presented) A device manufacturing method, comprising
the steps of:

exposing a wafer to a pattern on a mask by use of an exposure apparatus as
recited in Claim 172; and

developing the exposed wafer.